



wwPDB EM Validation Summary Report ⓘ

Apr 16, 2026 – 12:37 PM JST

PDB ID : 9L6Q / pdb_00009l6q
EMDB ID : EMD-62862
Title : Vitamin K-dependent gamma-carboxylase in complex with Coagulation factor IX and vitamin K
Authors : Hang, J.; Chen, D.D.; Zhong, Q.H.
Deposited on : 2024-12-25
Resolution : 2.78 Å(reported)

This is a wwPDB EM Validation Summary Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/EMValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

EMDB validation analysis : **FAILED**
Mogul : 1.8.5 (274361), CSD as541be (2020)
MolProbity : 4-5-2 with Phenix2.0
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics : **NOT EXECUTED**
MapQ : **FAILED**
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

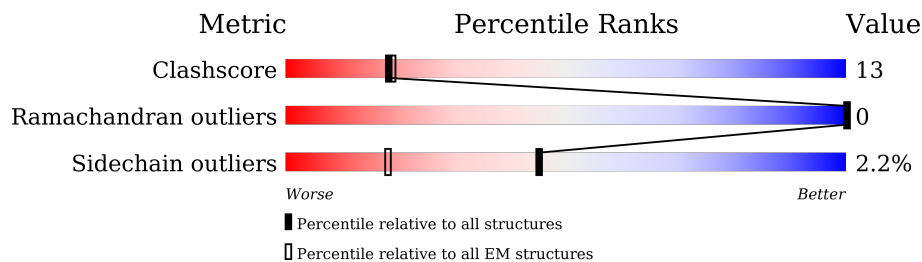
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 2.78 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	EM structures (#Entries)
Clashscore	229148	23984
Ramachandran outliers	224038	23583
Sidechain outliers	223484	23102

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	A	758	64% (green), 23% (yellow), 12% (grey)
2	C	461	5% (yellow), 93% (green), 2% (grey)
3	B	2	100% (yellow)
3	D	2	100% (green)
4	E	3	100% (green)

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
7	1L3	A	804	-	-	X	-

2 Entry composition [i](#)

There are 7 unique types of molecules in this entry. The entry contains 5893 atoms, of which 40 are hydrogens and 0 are deuteriums.

In the tables below, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

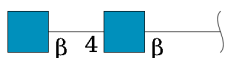
- Molecule 1 is a protein called Vitamin K-dependent gamma-carboxylase.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	665	5363	3510	897	930	26	0	0

- Molecule 2 is a protein called Coagulation factor IX.

Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
2	C	32	238	148	42	48	0	0

- Molecule 3 is an oligosaccharide called 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.



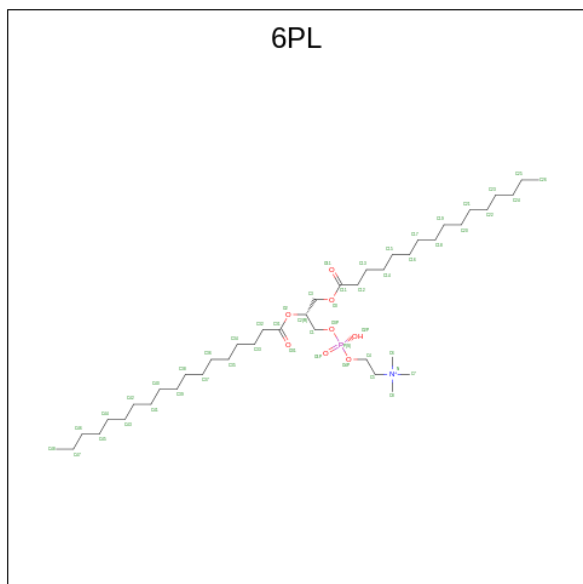
Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
3	B	2	28	16	2	10	0	0
3	D	2	28	16	2	10	0	0

- Molecule 4 is an oligosaccharide called beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.



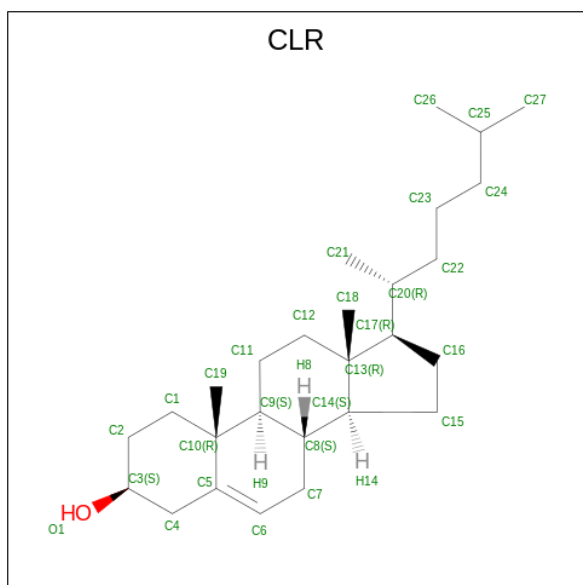
Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
4	E	3	39	22	2	15	0	0

- Molecule 5 is (4S,7R)-4-HYDROXY-N,N,N-TRIMETHYL-9-OXO-7-[(PALMITOYLOXY)METHYL]-3,5,8-TRIOXA-4-PHOSPHAHEXACOSAN-1-AMINIUM 4-OXIDE (CCD ID: 6PL) (formula: $C_{42}H_{85}NO_8P$) (labeled as "Ligand of Interest" by depositor).



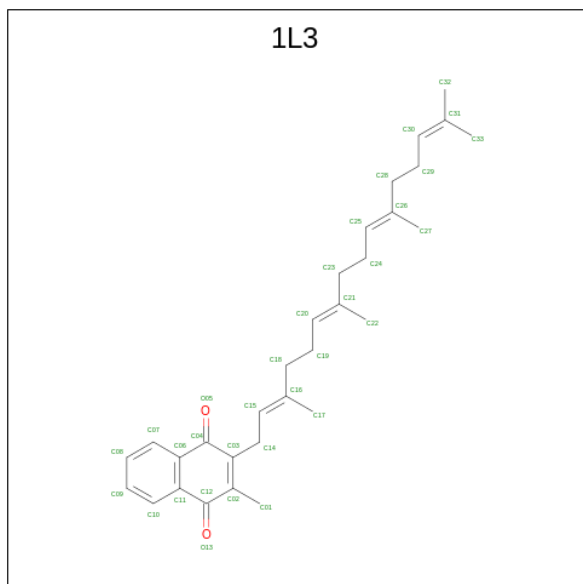
Mol	Chain	Residues	Atoms					AltConf
			Total	C	N	O	P	
5	A	1	Total	C	N	O	P	0
			50	40	1	8	1	
5	A	1	Total	C	N	O	P	0
			46	36	1	8	1	

- Molecule 6 is CHOLESTEROL (CCD ID: CLR) (formula: $C_{27}H_{46}O$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms			AltConf
6	A	1	Total	C	O	0
			28	27	1	

- Molecule 7 is Menaquinone-4 (CCD ID: 1L3) (formula: $C_{31}H_{40}O_2$) (labeled as "Ligand of Interest" by depositor).



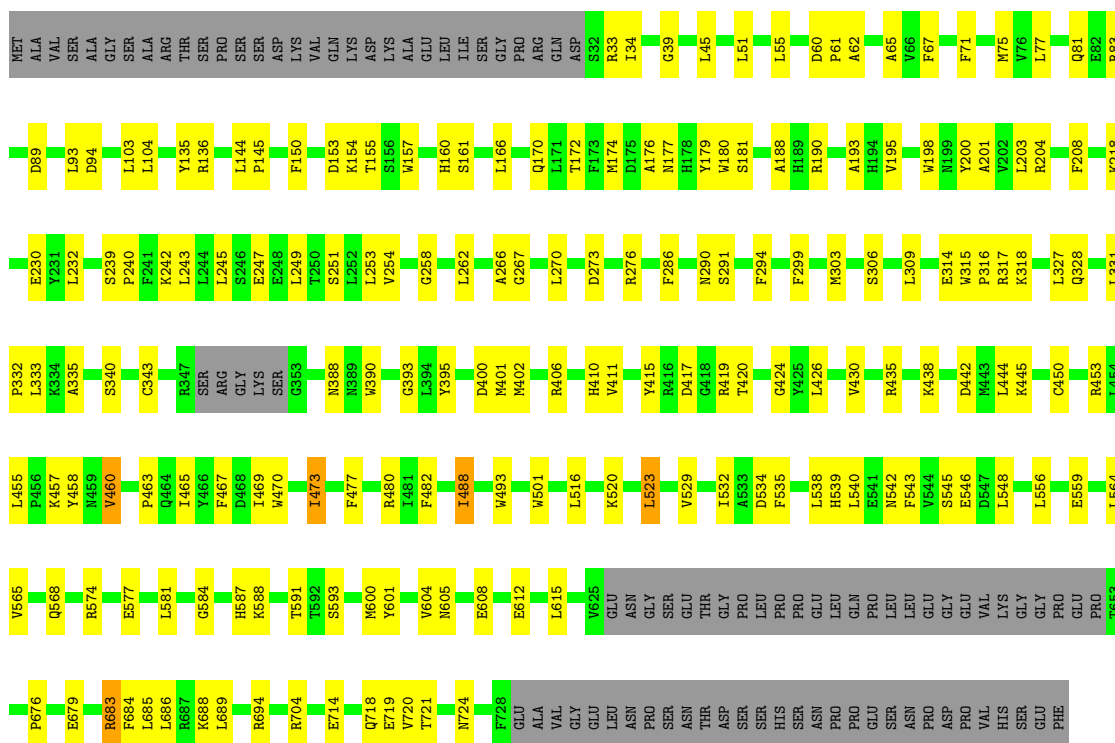
Mol	Chain	Residues	Atoms				AltConf
7	A	1	Total	C	H	O	0
			73	31	40	2	

3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

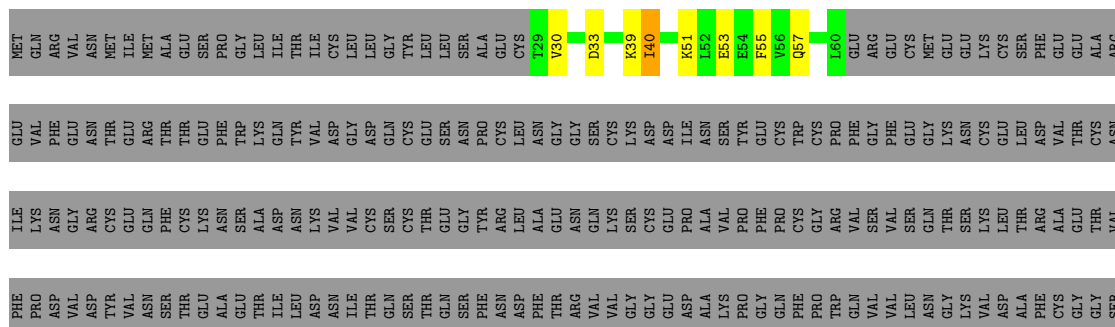
- Molecule 1: Vitamin K-dependent gamma-carboxylase

Chain A:  64% 23% 12%



- Molecule 2: Coagulation factor IX

Chain C:  5% 93%



ILE VAL ASN GLU LYS TRP ILE VAL THR THR ALA ALA HIS CYS VAL VAL GLU THR THR VAL VAL ALA ALA GLU HIS HIS ASN ARG ARG ILE ILE PRO HIS HIS ASN TVR ASN ALA ALA VAL ILE ILE ASN ASP

ILE ALA LEU LEU LYS LEU ASP GLU PRO THR LEU VAL VAL ASN SER TVR VAL THR THR VAL ILE CYS ILE ALA VAL ASP LYS ALA GLU TYR THR ASN ASN PHE LEU LYS PHE GLY HIS ASN ASN TRP VAL TRP ARG ARG ILE ILE HIS LYS GLY ARG SER ALA LEU VAL VAL ILE ILE ASN TVR LYS TYR LEU ARG VAL ASP

LEU VAL ASP ARG ALA THR CYS LEU ARG THR SER THR LYS PHE THR ILE TYR ASN MET PHE CYS ALA GLY PHE HIS GLU GLY ARG ASP PHE LEU CYS GLN GLY SER SER GLY GLY PRO HIS THR THR PHE LEU THR GLY ILE ILE SER PHE LEU THR GLY ILE ILE SER TVR LYS TYR LEU ARG VAL CYS

ALA MET LYS GLY TYR GLY ILE TYR THR LYS VAL SER THR ARG TYR VAL TRP ASN ILE LYS GLU THR LYS LEU THR

- Molecule 3: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain B:  100%

MAG1
MAG2

- Molecule 3: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain D:  100%

MAG1
MAG2

- Molecule 4: beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain E:  100%

MAG1
MAG2
EM/A3

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	331914	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TECNAI F30	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	40	Depositor
Minimum defocus (nm)	800	Depositor
Maximum defocus (nm)	1800	Depositor
Magnification	Not provided	
Image detector	GATAN K3 BIOCONTINUUM (6k x 4k)	Depositor

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: NAG, 1L3, 6PL, BMA, CLR

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# Z >5	RMSZ	# Z >5
1	A	0.25	0/5520	0.39	0/7515
2	C	0.30	0/241	0.42	0/326
All	All	0.25	0/5761	0.39	0/7841

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	5363	0	5204	144	0
2	C	238	0	212	9	0
3	B	28	0	25	1	0
3	D	28	0	25	0	0
4	E	39	0	34	0	0
5	A	96	0	143	15	0
6	A	28	0	46	0	0
7	A	33	40	0	22	0
All	All	5853	40	5689	151	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 13.

The worst 5 of 151 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:294:PHE:CE2	7:A:804:1L3:C01	2.21	1.24
1:A:254:VAL:HG13	7:A:804:1L3:C27	1.86	1.04
1:A:402:MET:SD	7:A:804:1L3:C01	2.57	0.92
1:A:254:VAL:HG12	7:A:804:1L3:C22	2.02	0.90
1:A:467:PHE:CE1	1:A:488:ILE:HG21	2.06	0.90

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	659/758 (87%)	650 (99%)	9 (1%)	0	100	100
2	C	30/461 (6%)	28 (93%)	2 (7%)	0	100	100
All	All	689/1219 (56%)	678 (98%)	11 (2%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	566/681 (83%)	555 (98%)	11 (2%)	50	78

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	C	24/403 (6%)	22 (92%)	2 (8%)	10	29
All	All	590/1084 (54%)	577 (98%)	13 (2%)	45	75

5 of 13 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	615	LEU
1	A	683	ARG
2	C	51	LYS
1	A	721	THR
2	C	40	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 7 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	542	ASN
1	A	554	GLN
2	C	48	ASN
1	A	718	GLN
1	A	478	GLN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates [i](#)

7 monosaccharides are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the

expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
3	NAG	B	1	1,3	14,14,15	0.25	0	17,19,21	0.44	0
3	NAG	B	2	3	14,14,15	0.22	0	17,19,21	0.43	0
3	NAG	D	1	1,3	14,14,15	0.24	0	17,19,21	0.41	0
3	NAG	D	2	3	14,14,15	0.23	0	17,19,21	0.44	0
4	NAG	E	1	1,4	14,14,15	0.28	0	17,19,21	0.56	0
4	NAG	E	2	4	14,14,15	0.24	0	17,19,21	0.52	0
4	BMA	E	3	4	11,11,12	0.91	0	15,15,17	0.93	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	NAG	B	1	1,3	-	2/6/23/26	0/1/1/1
3	NAG	B	2	3	-	4/6/23/26	0/1/1/1
3	NAG	D	1	1,3	-	2/6/23/26	0/1/1/1
3	NAG	D	2	3	-	4/6/23/26	0/1/1/1
4	NAG	E	1	1,4	-	2/6/23/26	0/1/1/1
4	NAG	E	2	4	-	2/6/23/26	0/1/1/1
4	BMA	E	3	4	-	0/2/19/22	0/1/1/1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

5 of 16 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	E	1	NAG	O5-C5-C6-O6
3	D	1	NAG	O5-C5-C6-O6
4	E	1	NAG	C4-C5-C6-O6
3	B	2	NAG	O5-C5-C6-O6
3	D	1	NAG	C4-C5-C6-O6

There are no ring outliers.

2 monomers are involved in 1 short contact:

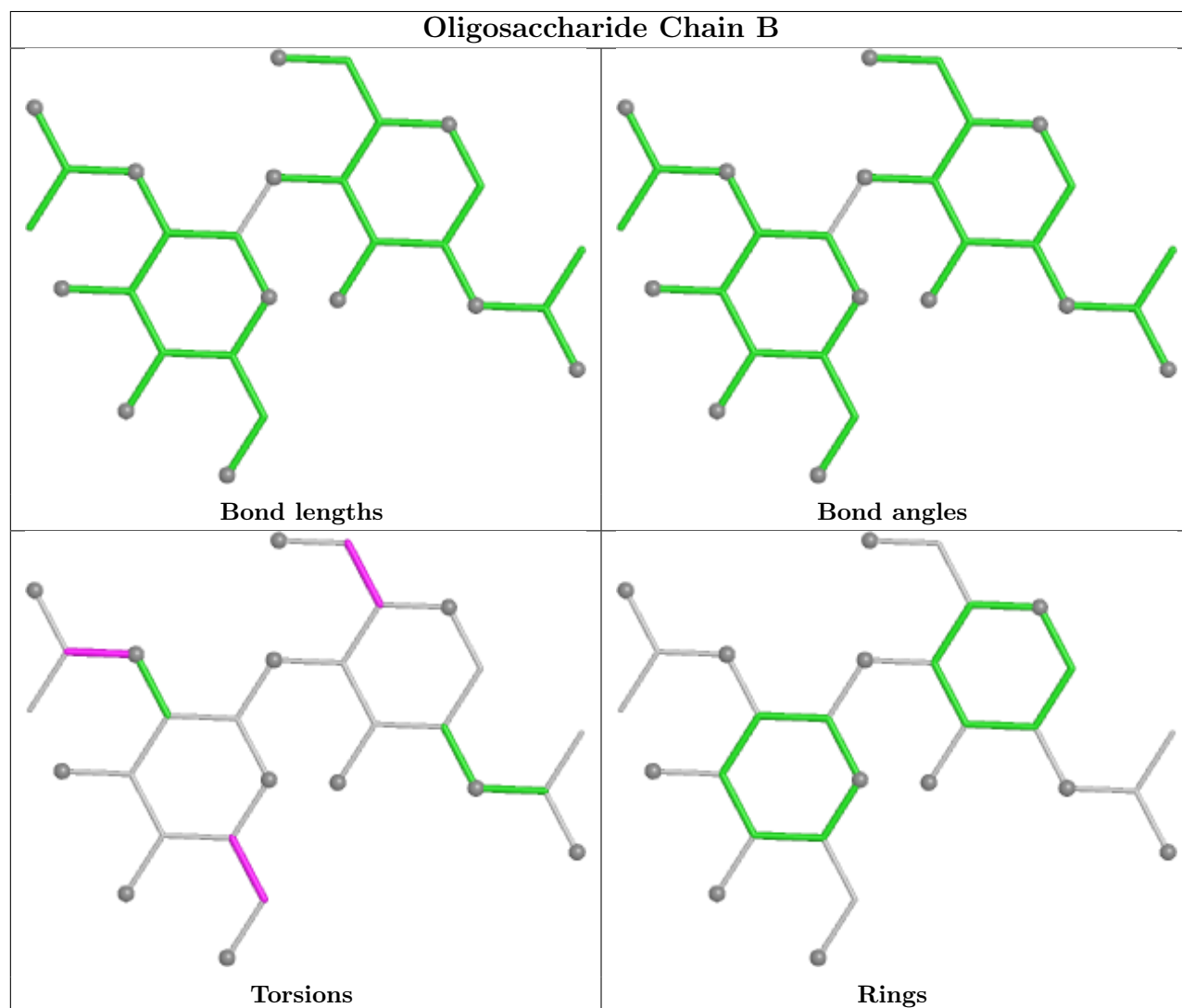
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	1	NAG	1	0

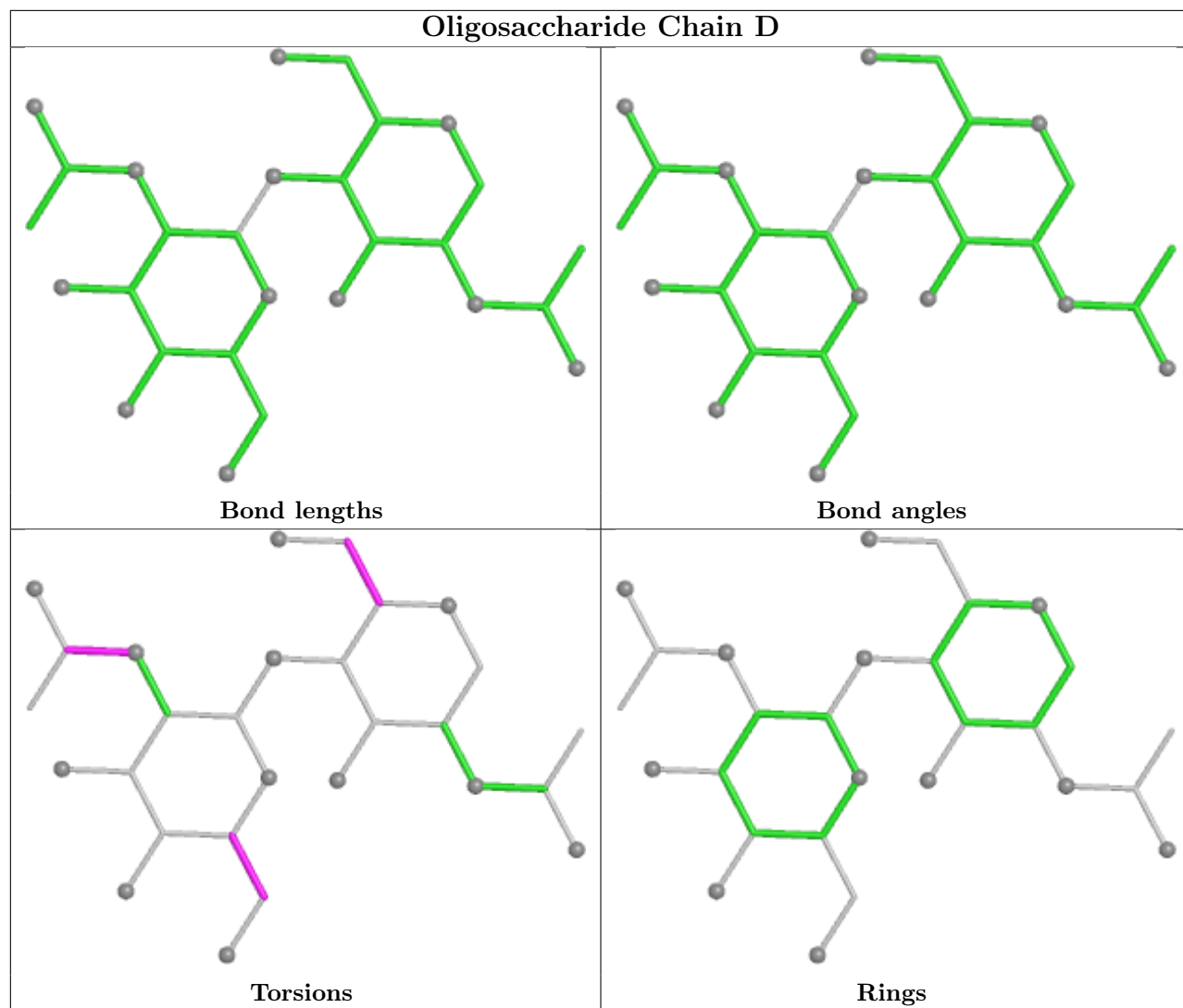
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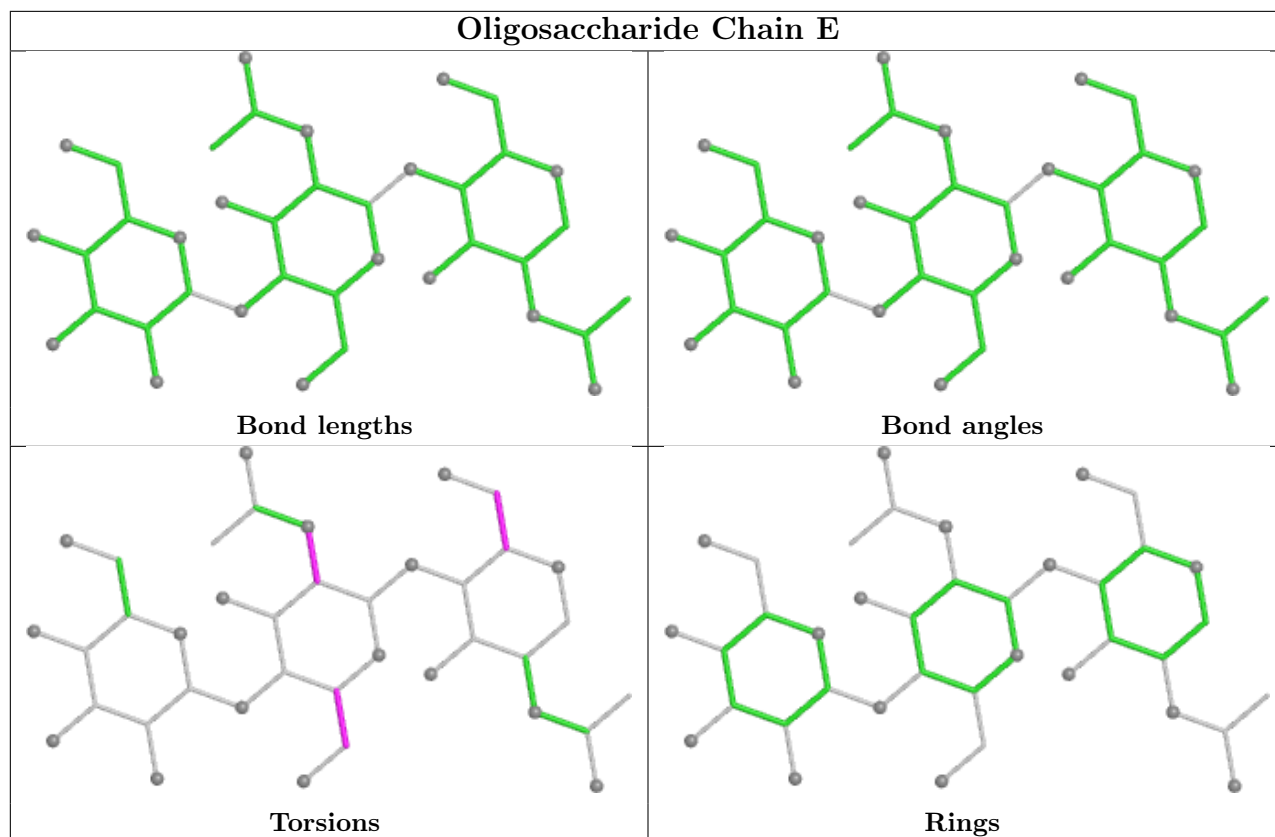
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Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	2	NAG	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for oligosaccharide.







5.6 Ligand geometry [i](#)

4 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# $ Z > 2$	Counts	RMSZ	# $ Z > 2$
7	1L3	A	804	-	34,34,34	2.75	12 (35%)	42,45,45	7.51	11 (26%)
5	6PL	A	801	-	49,49,51	0.31	0	55,57,59	0.34	0
6	CLR	A	803	-	31,31,31	0.38	0	48,48,48	0.60	0
5	6PL	A	802	-	45,45,51	0.28	0	51,53,59	0.34	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
7	1L3	A	804	-	-	8/23/43/43	0/2/2/2
5	6PL	A	801	-	-	16/53/53/55	-
6	CLR	A	803	-	-	4/10/68/68	0/4/4/4
5	6PL	A	802	-	-	12/49/49/55	-

The worst 5 of 12 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
7	A	804	1L3	C03-C02	8.44	1.50	1.35
7	A	804	1L3	C06-C04	4.94	1.57	1.48
7	A	804	1L3	C18-C16	4.73	1.61	1.51
7	A	804	1L3	C11-C12	4.63	1.57	1.48
7	A	804	1L3	C23-C21	4.11	1.59	1.51

The worst 5 of 11 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
7	A	804	1L3	C18-C16-C15	22.11	165.87	121.12
7	A	804	1L3	C17-C16-C18	-20.94	80.05	115.27
7	A	804	1L3	C22-C21-C20	17.23	167.89	123.68
7	A	804	1L3	C27-C26-C25	16.67	166.45	123.68
7	A	804	1L3	C27-C26-C28	-15.04	89.97	115.27

There are no chirality outliers.

5 of 40 torsion outliers are listed below:

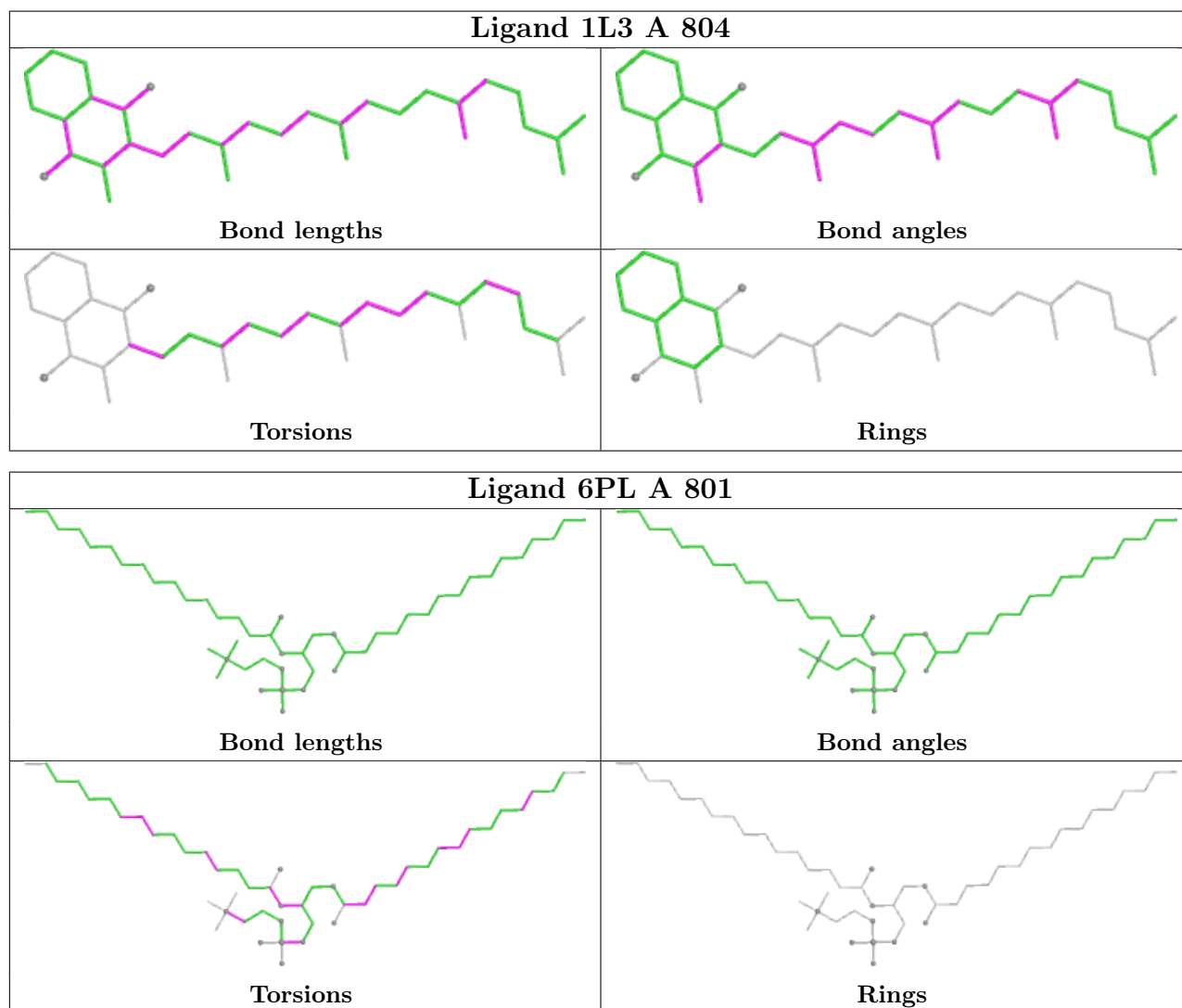
Mol	Chain	Res	Type	Atoms
5	A	802	6PL	C12-C11-O3-C3
5	A	802	6PL	O11-C11-O3-C3
7	A	804	1L3	C18-C19-C20-C21
7	A	804	1L3	C04-C03-C14-C15
7	A	804	1L3	C15-C16-C18-C19

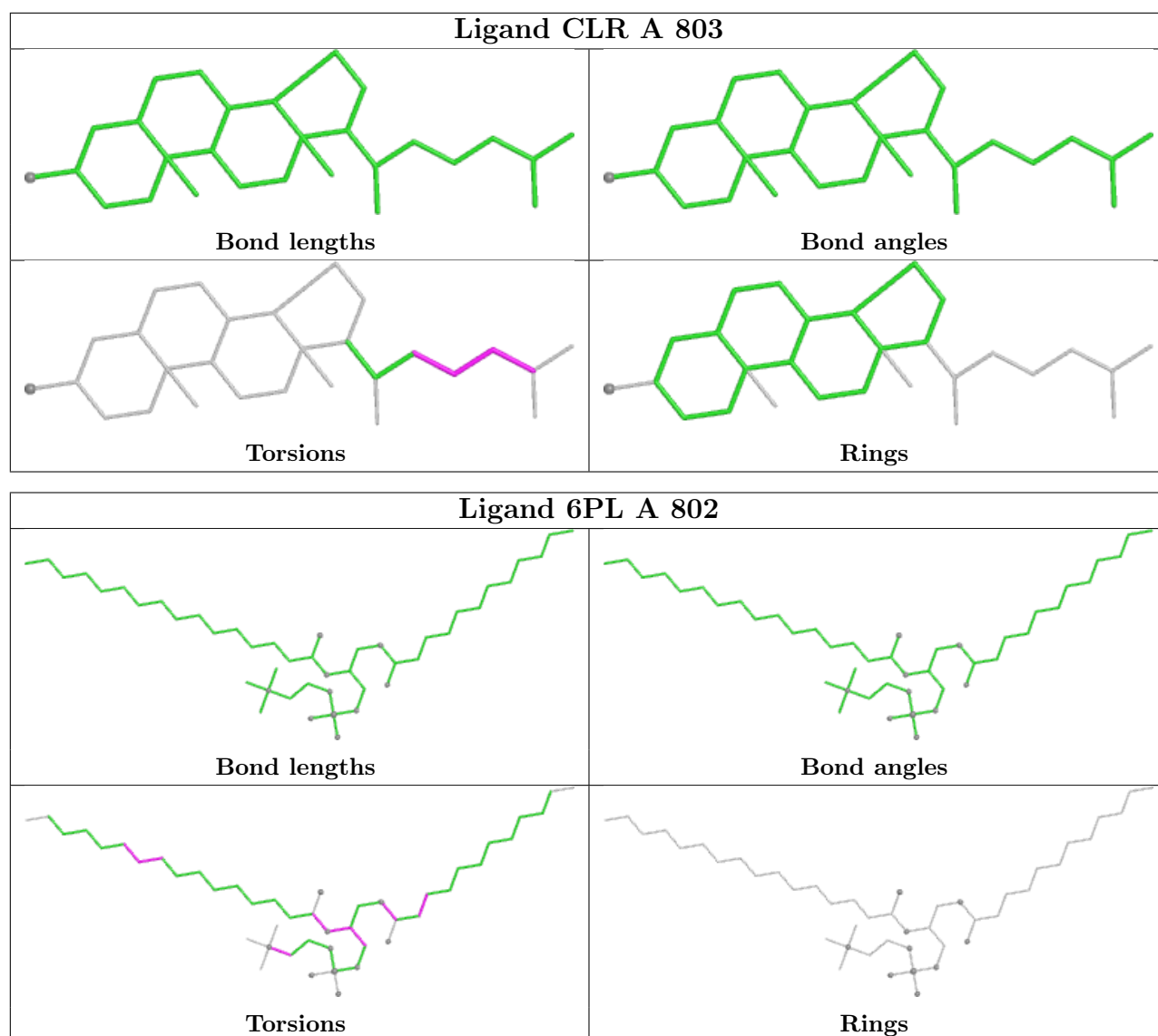
There are no ring outliers.

3 monomers are involved in 37 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
7	A	804	1L3	22	0
5	A	801	6PL	7	0
5	A	802	6PL	8	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.





5.7 Other polymers [\(i\)](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [\(i\)](#)

There are no chain breaks in this entry.